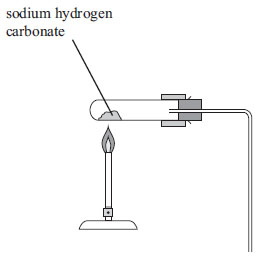
**Decomposition**

**1)** Two decomposition reactions were set up in the laboratory.

**Reaction 1:** Solid sodium hydrogen carbonate, NaHCO3, was heated over a Bunsen burner flame.

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Describe any observations that would be made as this reaction occurs, and link these to the reactants and products involved in the reaction.

(ii) Outline a test that could be used to confirm the presence of one of the products formed.

Write a balanced symbol equation for the decomposition of sodium hydrogen carbonate, NaHCO3.

**Reaction 2**: Test tube 1 and test tube 2 were both half-filled with hydrogen peroxide solution, H2O2. Some powdered manganese dioxide, MnO2, was then added to test tube 1.

(c) Compare the observations you would make for the reactions in the two test tubes.

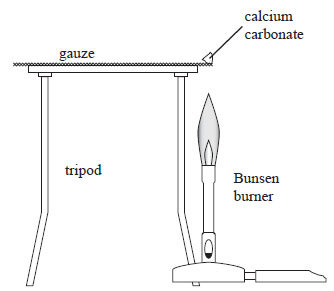
Link these observations to the reactants and products involved in the reactions.

(d) Write a balanced symbol equation for the reaction in test tube 1.

Compare and contrast the decomposition reactions shown in **Reaction 1** (sodium hydrogen carbonate, NaHCO3) and **Reaction 2** (hydrogen peroxide, H2O2).

2) Two calcium compounds were heated over a Bunsen burner in a school laboratory. In the first experiment, shown in the diagram below, **calcium carbonate** was heated.

In the second experiment, **calcium hydroxide** was heated.



**Compare and contrast** the reaction that occurs when solid calcium carbonate is strongly heated, with the reaction that occurs when solid calcium hydroxide is strongly heated.

In your answer:

 identify the type of reaction that occurs when each substance is strongly heated, and justify your choice

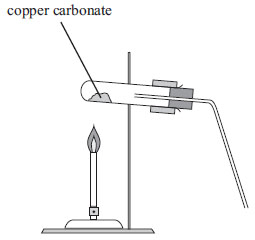
 describe any observations that would be made in each reaction, and link these observations to the reactants and

products involved

 explain how the gas formed in **each** reaction could be identified

 write a balanced symbol equation for **each** reaction.

**3)** In a reaction, a boiling tube with copper carbonate powder is heated over a Bunsen burner flame.



(i) Identify the type of reaction that occurs: Give a reason for your choice:

(ii) Describe any observations that would be made of this reaction, and link these to the substances involved in the

reaction.

Outline a test that could be used to confirm the presence of ONE of the products formed.

(iii) Write a balanced symbol equation for this reaction.

4) Two test tubes were set up in a school laboratory. Both test tubes were half-filled with identical solutions of hydrogen peroxide (H2O2).

It was observed that a few small bubbles of a colourless gas formed on the sides of each test tube.

Some solid manganese dioxide (MnO2) was added to test tube B.

(a) Describe the observations you would make after manganese dioxide (MnO2) was added to test tube B.

(b) Explain the chemistry of this reaction. In your answer you should:

 identify the type of reaction that happens in test tube B

 justify your choice of the type of reaction

 link the observations made for the reaction in test tube B to the substances involved in the reaction

 write a balanced symbol equation for the reaction involving hydrogen peroxide.

**5)** Students in a laboratory are asked to identify three powders by using a thermal decomposition reaction.

The powders are copper hydroxide, Cu(OH)2, sodium carbonate, Na2CO3, and sodium hydrogen carbonate, NaHCO3.

Explain how you could identify each of these powders by heating them. Your answer should include:

 any observations that would be made

 any tests that would be carried out on products formed to confirm their presence

 balanced symbol equations for any reactions occurring.

**6)** A group of students carried out an investigation into whether or not various solid carbonates undergo thermal decomposition. The students found that copper (II) carbonate did decompose when heated. Discuss the thermal decomposition of copper (II) carbonate. In your answer, you should:

name the products formed

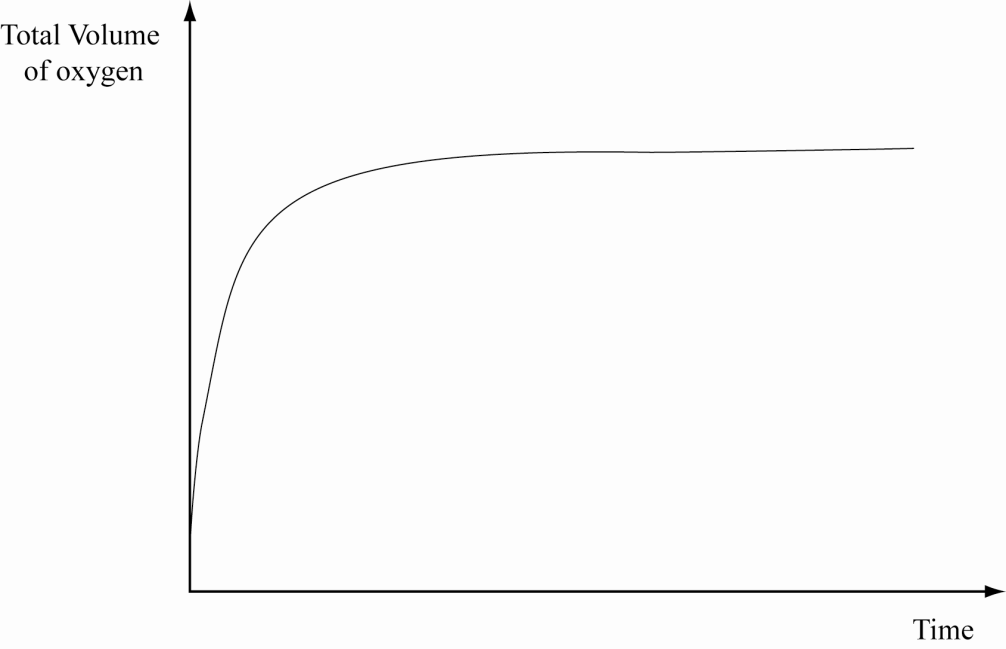
describe what would be observed during the decomposition

explain why a solution of limewater would be useful in this investigation

fully explain what happens to the carbonate ions in the decomposition reaction

write a balanced chemical equation for the decomposition reaction.

**7)** A solution of hydrogen peroxide decomposes into water and oxygen gas very slowly. A catalyst can be used to speed up this reaction. The sketch graph below shows the volume of oxygen produced over the course of time when a catalyst is used.



Discuss the decomposition of hydrogen peroxide using a catalyst. In your answer, you should:

name a catalyst that would be suitable for this reaction

describe what would be observed during the decomposition reaction

explain why only a small amount of catalyst is needed to catalyse this decomposition reaction

fully explain what happens in the catalytic decomposition of hydrogen peroxide over time as shown in the graph above.

**8)** Three carbonate compounds, sodium carbonate, zinc carbonate and copper carbonate, are heated one at a time in the apparatus shown in the diagram below.

|  |  |
| --- | --- |
|  |  |

Complete the following table for the above reactions.

(b) Discuss the differences in the decomposition of sodium carbonate, zinc carbonate, and copper carbonate. In your

answer:

 Describe the differences between the reactions of the three carbonates.

 Link the relevant species to the observations you recorded in the table in (a).

 Include any balanced equations.

**9)** Some green copper(II) carbonate powder is heated in a boiling tube over a Bunsen flame. A burning splint inserted into the top of the boiling tube goes out.

|  |  |
| --- | --- |
| Discuss the chemistry in this thermal decomposition reaction by:   describing ONE other observation that would be made during this reaction   linking the observations to the relevant chemical species   writing a balanced equation. |  |

**10)** Some dry copper(II) hydroxide was heated in a test tube over a Bunsen burner. When a piece of blue cobalt chloride paper was held in the mouth of the test tube, the paper turned pink. Discuss what happened in the reaction in the **test tube**.

Your answer should include any observations that would occur, and link all the observations to the reactants and products involved. Include an appropriate balanced equation in your answer.

**11)**



**12)** A small amount of zinc hydroxide is heated in a test tube over a Bunsen burner. The following reaction occurs.



(a) State what **type** of reaction is occurring.

(b) Fully describe the **observations** that would be expected if this reaction was carried out in a school laboratory. Remember to **link** your observations to the substances involved.

**13)** A group of students carried out an investigation into the thermal decomposition of the following solid carbonates: sodium carbonate, calcium carbonate, and copper carbonate.

(a) Describe the appearance of each carbonate before it was heated.

(b) Describe the observations the students would have made when heating each of the carbonates.

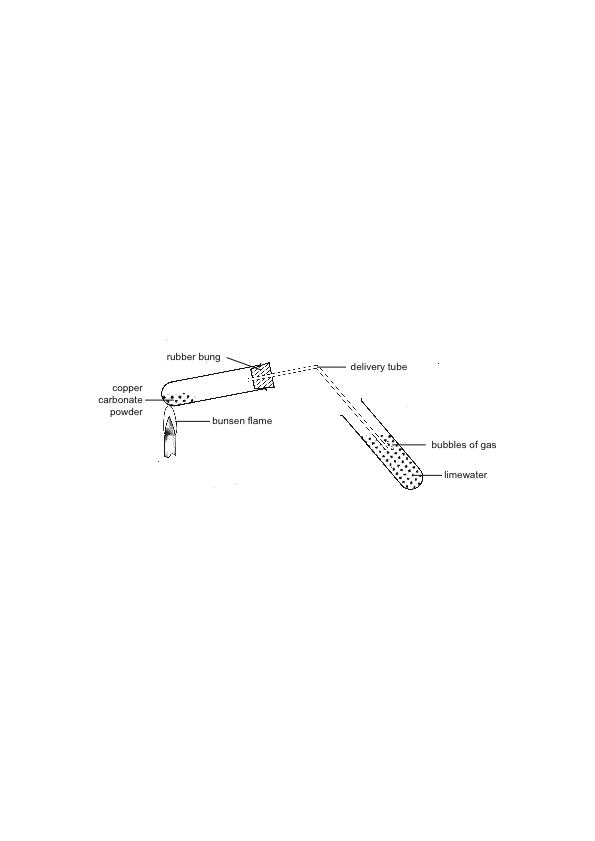
(c) Write a balanced equation for the thermal decomposition of copper carbonate.

**14)** 

**15)**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | copper hydroxide | →  heat |  | + |  |  |  |

**16)** A sample of copper carbonate is heated strongly in a boiling tube ﬁtted with a delivery tube. The gas formed is bubbled into limewater. (*See the diagram below.)*



(i) Describe TWO observations, other than bubbles of gas, that would be made:

(ii) Write a balanced equation for the reaction that occurs when copper carbonate is heated

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